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मानक

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IS 11424 (1985): Portable Prospecting Radiation Meters with Gamma-ray Scintillation Detectors (Linear Scale Instruments) [LITD 8: Electronic Measuring Instruments, Systems and Accessories]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard***SPECIFICATION FOR PORTABLE PROSPECTING RADIATION  
METERS WITH GAMMA-RAY SCINTILLATION DETECTORS  
( LINEAR SCALE INSTRUMENTS )****National Foreword**

This Indian Standard which is identical with IEC Pub 460 (1974) 'Portable prospecting radiation meters with gamma-ray scintillation detectors (linear scale instruments)', issued by the International Electrotechnical Commission (IEC) was adopted by the Indian Standards Institution on the recommendation of the Nuclear Instrumentation Sectional Committee, and approval of the Electronics and Telecommunication Division Council.

Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

**Cross References**

In this Indian Standard, the following International Standards are referred to. Read in their respective place the following:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>
IEC Pub 50 (20)-1958 Scientific and industrial measuring instruments	IS : 1885 (Part 11)-1966 Electrotechnical vocabulary : Part 11 Electrical measurements
IEC Pub 68-2 Basic environmental testing procedures: Part 2 Tests	IS : 9000 Basic environmental testing procedures for electronic and electrical items
IEC Pub 68-2-1 (1974) Test A : Cold (Test Ab)	IS : 9000 (Part 2/Sec 3)-1977 Cold test, Section 3 Cold test for non-heat dissipating items with gradual change of temperature
IEC Pub 68-2-2 (1974) Test B : Dry heat (Test Bb)	IS : 9000 (Part 3/Sec 3)-1977 Dry heat test, Section 3 Dry heat test for non-heat dissipating items with gradual change of temperature
IEC Pub 68-2-3 (1969) Test Ca : Damp heat, steady state	IS : 9000 (Part 4)-1979 Damp heat (steady state)
IEC Pub 68-2-6 (1982) Test Fc and guidance : Vibration (sinusoidal)	IS : 9000 (Part 8)-1981 Vibration (sinusoidal) test IS : 9001 (Part 13)-1981 Guidance for environmental testing : Part 13 Vibration (sinusoidal) test
IEC Pub 68-2-8 (1960) Test H : Storage [Superseded by IEC (Pub) 68-2-48 (1982)]	IS : 9001 (Part 14)-1981 Storage tests
IEC Pub 68-2-11 (1981) Test Ka : Salt mist	IS : 9000 (Part 11)-1983 Salt mist test
IEC Pub 68-2-13 (1983) Test M : Low air pressure	IS : 9000 (Part 13)-1981 Low air pressure test
IEC Pub 68-2-14 (1974) Test N : Change of temperature	IS : 9000 (Part 14)-1978 Change of temperature
IEC Pub 68-2-17 (1978) Text Q : Sealing (Test Qg*, Qf)	IS : 9000 (Part 15)-1982 Sealing test
IEC Pub 68-2-29 (1968) Test Eb : Bump	IS : 9000 (Part 7/Sec 2)-1979 Impact test, Section 2 Bump
IEC Pub 68-2-30 (1980) Test Db and guidance: Damp heat, cyclic (12+12 hour cycle)	IS : 9000 (Part 5)-1981 Damp heat (cyclic) test

\*Since withdrawn.

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**IS : 11424 - 1985**  
**IEC Pub 460 (1974)**

IEC Pub 68-2-32 (1975) Test Ed : Free fall (Procedure 1)	IS : 9000 (Part 7/Sec 4)-1979 Impact test, Section 4 Free fall
IEC Pub 86 (1982) Primary batteries	IS : 203-1972 Dry batteries for flashlights (third revision)
IEC Pub 201 (1966) Power sources for portable prospecting equipment for radioactive materials (see Note)	—
IEC Pub 278 (1968) Documentation to be supplied with electronic measuring equipment	IS : 6756-1972 Technical documentation to be supplied with electronic measuring equipment
IEC Pub 348 (1978) Safety requirements for electronic measuring apparatus	IS : 9858-1981 Safety requirements for measuring apparatus
IEC Pub 359 (1971) Expression of the functional performance of electronic measuring equipment	IS : 9176-1979 Method for specifying the functional performance of electronic measuring equipment

NOTE—The technical committee responsible for the preparation of this standard has reviewed the provisions of this IEC standard and has decided that it is acceptable for use in conjunction with this standard.

In Table 1, under 'standard test conditions', a temperature of  $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$  is specified against 'ambient temperature'. The technical committee responsible for the preparation of this Indian Standard has adopted a value of  $10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  which is internationally accepted in IEC Pub 68-1 (1982).

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard.

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## CHAPTER I: GENERAL

### 1. Scope

This recommendation applies to linear scale instruments used in general, regional and local prospecting and for subsurface survey and underground workings, excluding radiometric bore-hole logging probes.

They usually comprise the following parts:

- a detecting device with one or more scintillation detectors;
- a counting rate meter;
- a power supply;
- an audible device.

### 2. Object

The object of this recommendation is:

- to state requirements for instruments;
- to give the specifications to be provided in the instruction manual by the manufacturer (see IEC Publication 278, Documentation to be Supplied with Electronic Measuring Apparatus).

### 3. Terminology

The following definitions have been taken from the I.E.V.<sup>1)</sup> and IEC Publication 359, Expression of the Functional Performance of Electronic Measuring Equipment.

#### 3.1 Rating of an instrument (in terms of the quantity measured)

The value of the quantity which corresponds to the upper limit of an effective range (I.E.V. 20-40-050).

#### 3.2 Effective range

That part of the rated range where measurements can be made or quantities be supplied within the stated limits of error (IEC Publication 359).

*Note.* — An instrument may have several effective ranges.

#### 3.3 Influence quantity

One of the quantities which affect the indication of an instrument, but which is not the one measured by the instrument (I.E.V. 20-40-060).

<sup>1)</sup> Subject to modifications which may be made to the I.E.V., Chapter 20, third edition, at present under consideration.



**3.4 Reference condition <sup>1)</sup>**

A set of values with tolerances, or of restricted ranges of influence quantities, and if necessary of influencing characteristics, specified for making comparison and calibration tests.

**3.5 Intrinsic error <sup>1)</sup>**

The error determined under reference conditions.

**3.6 Operating error <sup>1)</sup>**

The error determined under rated operating conditions.

**3.7 Rated range of use <sup>1)</sup>**

The range of values for an influence quantity within which the requirements concerning operating error are satisfied.

**3.8 Rated operating conditions <sup>1)</sup>**

The whole of the effective ranges for performance characteristics and rated ranges of use for influence quantities, within which the performance of the apparatus is specified.

**3.9 Limit conditions of operation <sup>1)</sup>**

The whole of the ranges of values for influence quantities and performance characteristics (beyond the rated ranges of use and effective ranges respectively), within which an apparatus can function without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

*Note.* — The limit conditions will, in general, include overload.

**3.10 Conditions of storage and transport <sup>1)</sup>**

The whole of the conditions of temperature, humidity, air pressure, vibration, shock, etc., within which the apparatus may be stored or transported in an inoperative condition, without resulting damage or degradation of performance when it is afterwards operated under rated operating conditions.

**3.11 Accuracy class <sup>1)</sup>**

A group of apparatus which have, for one particular basic parameter, an accuracy designated by a common number, this being the limit of error expressed as a percentage or otherwise, when the apparatus is used under reference conditions. This common number is termed the class index.

**3.12 Sensitivity (of a measuring assembly)**

For a given value of the measured quantity, the ratio of the variation of the observed variable to the corresponding variation of the measured quantity.

**3.13 Coefficient of variation (of a set of measurements)**

The ratio between the standard deviation  $s$  and the absolute value of the arithmetic mean of a set of  $n$  measurements  $x_i$  given by the following formula:

$$V = \frac{s}{\bar{x}} = \frac{\sqrt{\frac{\sum_1^n (x_i - \bar{x})^2}{n - 1}}}{\bar{x}}$$

where:  $x_i$  is the  $i^{\text{th}}$  indication given by the instrument ( $i = 1, 2, 3 \dots, n$ ) and  $\bar{x}$  is the arithmetic mean of the  $n$  indications taken into consideration.

<sup>1)</sup> Definition taken from IEC Publication 359.

**3.14 Response time (of a measuring assembly) <sup>1)</sup>**

The time required after a step variation in the measured quantity for the output signal variation to reach for the first time a given percentage of its final value.

**3.15 Counting loss <sup>1)</sup>**

A reduction of the observed counting rate due to the resolving time or to losses caused by phenomena such as pile-up.

**3.15.1 Fractional counting loss (of a pulse counting assembly)**

Counting loss referred to the number of received data.

**3.16 Threshold of detectability**

The least value of change of counting rate which can be distinguished on the meter from the statistical fluctuations in the measured value at a given confidence level.

**3.17 Discrimination threshold (of a radiation meter)**

A predetermined minimum value for the input signal amplitude above which the radiation meter provides an output signal.

When the radiation meter comprises a linear detector, the discrimination threshold may be expressed in keV.

**4. Categories of instruments**

Two categories of instruments are defined:

- *Category A*: instruments intended for exploration in temperate and tropical regions,
- *Category B*: instruments intended for exploration in cold regions.

The categories differ in the environmental conditions that the instruments are able to withstand and which are described in Clause 9.

These categories are further subdivided into accuracy classes according to Clause 6.

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<sup>1)</sup> Definition taken from IEC Publication 359.

## CHAPTER II: REQUIREMENTS

### 5. Test conditions

Except where otherwise specified, the standard test conditions to be applied are given in Table I.

With the exception of the check of intrinsic error and of performance characteristics, the tests enumerated in this publication are to be considered as "sampling tests", that is, it is not intended that they shall be carried out on all instruments of a given type, but only on some representative instruments of this type.

The checks of intrinsic error and of performance characteristics (Clause 6) shall be carried out on each instrument.

TABLE I  
*Reference conditions and standard test conditions*

Influence quantity	Reference conditions <sup>1)</sup>	Standard test conditions
Warm-up time	10 min	$\geq 10$ min
Ambient temperature	20 °C <sup>2)</sup>	$20 \pm 1$ °C <sup>2)</sup>
Relative humidity	65%	45% to 75% <sup>2)</sup>
Atmospheric pressure	1 013 mbar <sup>2)</sup> (101.3 kPa)	700 mbar to 1 060 mbar <sup>2)</sup> (70.0 kPa to 106.0 kPa)
Power supply voltage	Nominal power supply voltage	Nominal power supply voltage $\pm 5\%$
Position	Normal position as stated by the manufacturer <sup>2)</sup>	Normal position $\pm 5^\circ$
Magnetic induction of external origin	Earth's magnetic field	Less than twice the induction due to the Earth's magnetic field

<sup>1)</sup> See Sub-clause 3.4.

<sup>2)</sup> Value taken from IEC Publication 359.

### 6. Accuracy

#### 6.1 Intrinsic error

Under standard test conditions (Table I) with the radiation meter adjusted according to the manufacturer's instructions, the assembly shall measure the fluence rate, for the specified incident radiation (under consideration) and in the prescribed calibration direction. At any point of any effective range, the intrinsic error shall not exceed the following values, according to accuracy class:

Class 5 = 5% of the upper limit of the effective range.

Class 10 = 10% of the upper limit of the effective range.

Class 20 = 20% of the upper limit of the effective range.

#### 6.2 Error for rated operating conditions

The rated operating conditions shall be defined as follows:

Temperature <sup>1)</sup> = Category A:  $-10$  °C to  $+40$  °C,  
Category B:  $-25$  °C to  $+30$  °C.

Atmospheric pressure = 700 mbar to 1 060 mbar.

Relative humidity = 10% to 95%.

Power supply voltage = for a range corresponding to the battery lifetime, as specified by the manufacturer.

<sup>1)</sup> See Sub-clause 9.1.1.

In these conditions, the operating error shall not exceed the following values, according to accuracy class:

Class 5 = 7% of the upper limit of the effective range.

Class 10 = 15% of the upper limit of the effective range.

Class 20 = 30% of the upper limit of the effective range.

### 6.3 Error for limit conditions of operation

The limit conditions of operation shall be defined as follows:

Temperature <sup>1)</sup> = Category A: - 25 °C to + 55 °C,  
Category B: - 40 °C to + 40 °C.

The other quantities have the same value as specified for the rated operating conditions.

The maximum error for limit conditions of operation shall not exceed the following values, according to accuracy class:

Class 5 = 9% of the upper limit of the effective range.

Class 10 = 20% of the upper limit of the effective range.

Class 20 = 40% of the upper limit of the effective range.

## 7. Intrinsic requirements

### 7.1 Size and mass

#### 7.1.1 Detection sub-assembly

- The detection sub-assembly should be preferably of cylindrical form.
- The detector must permit recognition of weak anomalies in ores usually met in prospecting. To attain this, a NaI(Tl) crystal with dimensions not less than 25 mm × 25 mm, or any scintillator with equivalent stopping power, shall be used.

#### 7.1.2 Complete assembly

- The largest dimension of the assembly shall not exceed 0.50 m.
- The mass of the assembly shall not exceed:
  - 5 kg for instruments with adjustable discrimination,
  - 3.5 kg for instruments with non-adjustable discrimination.

### 7.2 Scale graduation

7.2.1 To make comparisons easier, it is desirable that all the instruments be graduated in the same unit or at least that the given indications may be converted into this same unit. The recommended unit is the fluence rate for a degenerated spectrum corresponding with the spectrum usually met in prospecting work, where the medium is regarded as semi-infinite ( $2\pi$ ).

If the instrument scale is graduated in fluence rate, the manufacturer shall furnish for each range the relationship between the graduation and the mean number of events detected per unit time, at least at one-third of each range.

7.2.2 When the instrument scale is graduated in mean number of events detected per unit time, the manufacturer shall specify the conditions under which the calibration was obtained. Further, the manufacturer shall furnish such spectral, directional and other response data necessary for converting the read-out to fluence rate, at least at one-third of each range. The unit time shall be the second.

<sup>1)</sup> See Sub-clause 9.1.1.

7.3 Effective ranges <sup>1)</sup>

- The instrument shall comprise at least three effective ranges which shall be continuous.
- The ratio of the maximum value of the highest range to the maximum value of the lowest range shall be not less than 10<sup>2</sup>. It shall be possible to carry out measurements from the lowest to the maximum values likely to be encountered in exploration.
  - The ratio between successive ratings shall be not greater than 10 and should be preferably between 2 and 5.

7.4 Counting ratemeter characteristics

7.4.1 Coefficient of variation

- Coefficient of variation determined at one-third of each range of the instrument shall be within one of the following series:

$0.5\% - 0.10\% - 0.20\%.$

7.4.2 Response time

- Response time shall be determined at 86.5% of the final value; this corresponds to twice the time constant of the instrument.
- It shall not exceed 10 s.

7.4.3 The manufacturer shall indicate if he has determined the two characteristics in Sub-clauses 7.4.1 and 7.4.2 by calculation, or by test; if by test, the method used shall be described.

TABLE II  
*An example of the characteristics of a counting ratemeter having five ranges*

Rating <sup>2)</sup> expressed in counts/second	Coefficient of variation (%)	Time constant (s)	Response time (s)
15 000	4.1	0.06	0.12
5 000	5.9	0.06	0.12
1 500	5	0.4	0.8
500	7	0.6	1.2
150	13	0.6	1.2
150 *	5	4	8

\* "Test" position.

7.5 Fractional counting rate loss

Fractional counting rate loss determined for the maximum value of each effective range of the instrument shall not exceed 10%.

7.6 Threshold of detectability <sup>3)</sup>

The threshold of detectability shall be determined at one-third of the lowest rating <sup>2)</sup> of the instrument at the confidence level corresponding to three times the standard deviation of the measurement at this point, i.e. about 99%.

In the example given in Table II, the values of the threshold of detectability determined at one-third of the lowest rating (i.e. at 50 counts/second) are 19.5 and 7.5 for coefficients of variation of 13% and 5% respectively.

7.7 Zero drift

The assembly is switched on for a period of 30 min, in normal operating conditions, and an initial zero setting is made. During the following 8 h, the position of the meter zero indication shall not vary by more than 1% of full-scale deflection on any range.

<sup>1)</sup> See Sub-clause 3.2.  
<sup>2)</sup> See Sub-clause 3.1.  
<sup>3)</sup> See Sub-clause 3.16.

### **7.8 Warm-up time**

After 2 min warm-up, the error shall not exceed twice the error limits respectively stated in Sub-clauses 6.1, 6.2 and 6.3. After 10 min, the deviation shall not exceed those limits.

### **7.9 Discrimination threshold**

The energy level of discrimination threshold (the lowest threshold for adjustable discrimination) shall be  $30 \pm 20$  keV.

### **7.10 Audible device**

The audible device, if any, shall provide a response independent of the time constant of the measuring device.

### **7.11 Operating position**

The instrument shall operate satisfactorily in any position differing less than  $30^\circ$ <sup>1)</sup> from the reference position.

## **8. Power supply requirements**

### **8.1 Type of power supply**

The instruments shall permit the use of primary cells of the "R 20" type, as defined in IEC Publication 86, Primary Cells and Batteries, as the source of power, except where dimensional specifications preclude the use of these cells. Several primary cells may be connected in any desired manner, but each shall be individually replaceable (see IEC Publication 201, Power Sources for Portable Prospecting Equipment for Radio-active Materials).

### **8.2 Battery lifetime**

In continuous service, battery lifetime shall correspond to one of the three following categories of instruments:

- long lifetime: longer than 100 h,
- medium lifetime: from 25 h to 100 h,
- short lifetime: from 10 h to 25 h.

Battery check facilities shall be provided and marking shall state the voltage corresponding to the time when the batteries have to be changed.

### **8.3 Effect of supply voltage variation**

The total error, including the error due to the modifications in power supply voltage corresponding to the battery lifetime specified by the manufacturer, shall remain for rated operating conditions within the error limits of Sub-clause 6.2, or for limit conditions of operation of Sub-clause 6.3.

## **9. Requirements for resistance to environmental conditions**

The instrument shall withstand the following environmental conditions:

### **9.1 Climatic conditions (instrument in the operating state)**

#### **9.1.1 Dry heat and cold**

- The rated operating conditions for temperature shall be:

*Category A*  
— 10 °C to + 40 °C

*Category B*  
— 25 °C to + 30 °C

<sup>1)</sup> Value taken from IEC Publication 359.

— Limit conditions of operation for temperature shall be:

*Category A*

– 25 °C to + 55 °C

*Category B*

– 40 °C to + 40 °C

— Tests shall be carried out in conformity with IEC Publication 68-2-1, Basic Environmental Testing Procedures, Part 2: Tests—Tests A: Cold, and with IEC Publication 68-2-2, Tests B: Dry Heat.

### 9.1.2 Damp heat

— The rated operating conditions for temperature shall be:

*Category A*

25 °C to 40 °C

*Category B*

25 °C to 40 °C

— Tests shall be carried out in conformity with IEC Publication 68-2-30, Test Db: Damp Heat, Cyclic (12 + 12 Hour Cycle).

## 9.2 Storage and transport conditions (instrument switched off)

### 9.2.1 Dry heat and cold

For a period of at least two months, with the instrument packed for transportation, at the following temperature range:

*Category A*

– 25 °C to + 55 °C

*Category B*

– 40 °C to + 55 °C

— Tests shall be carried out in conformity with IEC Publication 68-2-8, Test H: Storage, and IEC Publication 68-2-1 and IEC Publication 68-2-2.

### 9.2.2 Damp heat

— For a period of at least two months, instrument unpacked, at following temperature:

*Category A*

40 °C

*Category B*

40 °C

— Tests shall be carried out in conformity with IEC Publication 68-2-3: Test Ca: Damp Heat, Steady State, with the following severity, instrument switched off, unpacked, and power supply taken out:

56 days, the temperature and relative humidity maintained at  $40 \pm 2$  °C and  $93 \begin{smallmatrix} +2 \\ -3 \end{smallmatrix} \%$ .

The recommended series of operations consists of the following: 2 tests in the operating state, 1 test in storage conditions, recovery under standard atmospheric conditions for not less than 1 h nor more than 2 h, and 1 test in the operating state.

### 9.2.3 Rapid changes of temperature

*Category A*

from – 10 °C to + 30 °C

*Category B*

from – 10 °C to + 30 °C

— Tests shall be carried out in conformity with IEC Publication 68-2-14, Test N: Change of Temperature. Each temperature shall be maintained for 3 h, the time of the change over shall be not less than 2 min nor more than 3 min.

### 9.2.4 Low air pressure

— Transport for a period of at least 12 h, instrument packed, for categories A and B with a pressure of 300 mbar (corresponding to an altitude of 8 500 m).

— Tests shall be carried out in conformity with IEC Publication 68-2-13, Test M: Low Air Pressure.

### 9.3 *Waterproofing*

#### 9.3.1 *Rain and splash*

- The instrument, in its usual operating position and in the operating state, shall be subject to the driving rain test, the spray directed downwards at an angle of 45° for a period of 1 h.
- The variation of the indication given by the instrument, when put in operation again, shall not exceed that from the intrinsic error.
- Tests shall be carried out in conformity with IEC Publication 68-2-17, Test Qg: Driving Rain.

#### 9.3.2 *Immersion*

- If the instrument is stated to be “waterproof”, it shall be capable of immersion without damage under 1 m of water for a period of 30 min.
- If the instrument is claimed to be “unsinkable”, it shall withstand a fall into water from a height of 1 m and then float.
- Tests shall be carried out in conformity with IEC Publication 68-2-17, Test Qf: Immersion.

### 9.4 *Salt mist*

If specified:

- Tests shall be carried out in conformity with IEC Publication 68-2-11, Test Ka: Salt Mist.

### 9.5 *Explosive atmosphere*

If the instrument is to be used in an explosive atmosphere it shall conform with IEC recommendations and with the safety regulations of the country of operation and shall have received the necessary certificates of agreement.

### 9.6 *Vibration*

- The instrument, packed for transportation, shall withstand without damage vibrations of amplitude 1 mm peak-to-peak in the frequency range from 10 Hz to 55 Hz.
- Tests shall be carried out in conformity with IEC Publication 68-2-6, Test Fc: Vibration (sinusoidal).
- The instrument, packed for transportation, shall undergo a 1 h proof of endurance for vibration in each of three specified directions, of amplitude 1 mm from peak-to-peak with continuous sweeping from 10 Hz to 55 Hz in 1 min. The variation of the indication given by the instrument in operation before and after the test shall not exceed 5% of the rating.<sup>1)</sup>

### 9.7 *Bumps*

- The instrument, switched off, shall withstand without damage bumps corresponding to pulses of peak acceleration 5 g with a repetition rate of a bump every 2 s.
- Tests shall be carried out in conformity with IEC Publication 68-2-29, Test Eb: Bump.
- The instrument, switched off, shall be subject to 100 bumps in each of three-perpendicular directions corresponding to pulses of peak acceleration 5 g with a repetition rate of a bump every 2 s.
- The variation of the indication given by the instrument in operation before and after the test shall not exceed 5% of the range.

### 9.8 *Falls*

- 9.8.1 The instrument, in its operating condition, shall withstand without damage one fall onto concrete from a height of 0.25 m without preventing it from operating and the variation of the indication after the fall shall not exceed 5% of the rating.<sup>1)</sup>

<sup>1)</sup> See definition under Sub-clause 3.1.



9.8.2 The instrument, switched off and packed, shall withstand without damage one fall onto concrete from a height of 1 m.

Variation of the indication given by the instrument put in operation again shall not exceed 5% of the rating.<sup>1)</sup>

Tests shall be carried out in conformity with IEC Publication 68-2-32, Test Ed: Free Fall.

## 10. Safety requirements

The instruments shall comply with the safety requirements of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus.

Furthermore, the external connections of instruments which operate at a voltage greater than safety extra-low voltage shall comply with the following requirements against electric shock:

### 10.1 *Electrical connection of accessible external metal parts*

The instruments shall belong to safety Class II.<sup>2)</sup>

All accessible external conductive parts of safety Class II instruments (air and land vehicle-mounted instruments and portable self-powered instruments) shall be at the same potential. They shall be set up so that no dangerous difference of voltage appears between the instrument and neighbouring conductive parts.

### 10.2 *Protective device for accessible parts of live connectors (excluding safety extra-low voltage)*

#### 10.2.1 *Impedance as seen from the exterior*

The circuit impedance, as seen from the exterior of accessible live conductors, shall be as high as possible consistent with the proper functioning of the instrument.

10.2.2 The maker shall specify the maximum direct current which would flow through a 2 000 ohms resistance connected between accessible parts of live connectors and between these accessible parts and external metal.

#### 10.2.3 *Mechanical protective device*


The connectors carrying such circuits as supply, bias, etc., and when not mated presenting accessible live parts, shall be protected by a cover.

### 10.3 *Marking*


The instruments shall be marked as follows according to the maximum direct current as defined in Sub-clause 10.2.2.

2 mA: Direct currents below 2 mA (current recognized as unable to cause a significant electric shock).

2-25 mA: Direct currents between 2 mA and 25 mA (current, not necessarily safe, that, if flowing through the human body, corresponds to the so-called "safety" maximum voltage).

 Direct currents higher than 25 mA (currents recognized as unsafe).

The marking shall be made on the instrument near the connector(s).

The marking  will be made in red.

<sup>1)</sup> See definition under Sub-clause 3.1.

<sup>2)</sup> As defined in IEC Publication 348.

### CHAPTER III: SPECIFICATIONS TO BE GIVEN IN THE INSTRUCTION MANUAL

IEC Publication 278, Documentation to be Supplied with Electronic Measuring Apparatus, requires the instruction manual as a mandatory document. This instruction manual shall contain "the information necessary for the correct application, operation, maintenance and repair of the apparatus and for understanding its operation".

In addition to the main characteristics to be given in conformity with Publication 278, the manufacturer shall state the characteristics as listed below in Clauses 11 to 16.

#### 11. General characteristics

11.1 The purpose of all inputs and outputs together with their mechanical and electrical characteristics.

11.2 The dimensions in millimetres and the mass in kilogrammes of the instruments and accessories when ready for use; also those of the carrying case, if separate. Those of the accessories may be given separately, if appropriate.

11.3 The dimensions and the mass of the instrument and accessories when packed for transportation.

11.4 The type and dimensions of the "detection" part of the instrument.

#### 12. Power supply specifications

- The type, number and rated voltage of batteries.
- The battery lifetime in continuous service for the upper limit of the effective range.
- The battery lifetime in intermittent service for the operating time of 4 h per day.

#### 13. Performance characteristics

13.1 Under reference conditions:

- Intrinsic error and accuracy class.
- The sensitivity expressed in millimetres of deflection on the meter scale per photon  $m^{-2} \cdot s^{-1}$  on the most sensitive range.
- All data necessary for converting the graduation into the average number of detected events per unit time, or graduation into fluence rate, as specified in Sub-clause 7.2.
- The coefficient of variation at the one-third value of each range of the instrument.
- The response time determined at 86.5% of the final value.
- The fractional counting loss at the maximum value of each range of the instrument.
- The threshold of detectability at the one-third value of the most sensitive range for the confidence level corresponding to three times the standard deviation at this point.
- The zero drift in each range over 8 h.
- The warm-up time at the one-third value of the most sensitive range of the instrument.
- The discrimination threshold expressed in keV.

13.2 Under rated operating conditions:

- The accuracy.

13.3 Under limit conditions of operation:

- The accuracy.

**14. Storage and transport conditions**

- The climatic conditions of storage and transport.
- The maximum deviation of the instrument resulting from vibration, bumps and falls as specified in Sub-clauses 9.6, 9.7 and 9.8.

**15. Safety characteristics**

- The maximum direct current as defined in Sub-clause 10.2.2.

**16. Reliability characteristics**

- The results of calculation or tests used to determine the reliability.